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Ferroalloys

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This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

Ferroalloys

By Clark R. Neuharth[1]

Demand for ferroalloys increased in many countries compared with that of 1986, owing to increased consumption by the iron and steel and aluminum industries. Prices for ferroalloys rose steadily as supplies tightened, and a continuing production shift from traditional suppliers to developing countries was observed as plant closings occurred in some industrialized countries. Overall world production was little changed.

Domestic Data Coverage.—Domestic production data for ferroalloys are developed by the Bureau of Mines by means of monthly and annual voluntary domestic surveys. Typical of these surveys are the three separate monthly surveys for chromium alloys and metal, manganese alloys and metal, and silicon alloys and metal, and the annual survey for ferroalloys. Of the 41 operations to which a survey was sent, 31 responded, representing an estimated 76% of the total production and/or shipments shown in table 2. Production and shipments for the remaining 10 nonrespondents were estimated using reported prior year production and shipment levels adjusted by trends in employment and other guidelines.

Legislation and Government Programs.—House bill (H.R.) 3, entitled "The Omnibus Trade Act of 1987" in the House of Representatives and its companion Senate version, Senate bill (S.) 490, were introduced early in the year. The purpose of S. 490, which was subsequently passed by the Senate and incorporated into H.R. 3, was to revise trade remedy statutes, such as dumping and subsidy laws. H.R. 3 would create sweeping changes in existing trade laws covering import relief and other aspects of international competitiveness.

S. 556 and its counterpart, H.R. 1580, were subsequently introduced for the purpose of prohibiting U.S. investment in and trade with the Republic of South Africa. However, both bills included clauses exempting any minerals or materials considered by the President and Congress to be strategic to defense needs. This exemption probably would include ferroalloys and related ores. As required by section 303(a)(2) of the Comprehensive Anti-Apartheid Act of 1986, the U.S. Department of State certified 10 strategic minerals as essential for the economy or defense of the United States and unavailable in adequate quantities from reliable and secure suppliers. The list included chromium, manganese, vanadium, and their respective ferroalloys. Section 501 of the act required the Department of State to submit a report to the President assessing the yearlong effects of selected sanctions on the Republic of South Africa and what effect they had on dismantling apartheid. Also, section 504 required that the Administration study alternative sources for ferroalloys to cut the Country's dependency on the Republic of South Africa for ferroalloys and other metals.

The General Services Administration awarded 2-year contracts to Macalloy Corp. and Elkem Metals Co. for upgrading National Defense Stockpile chromite ore and manganese ore, respectively, into high-carbon ferrochromium (H-C-FeCr) and high-carbon ferromanganese (H-C-FeMn). Continuance of the upgrading program, which began in 1984, was authorized for fiscal years 1987-93 under Title II—National Defense Stockpile of the Defense Authorization Act of 1987. The defense authorization legislation also transferred the power to set National Defense Stockpile goals from the President to the Congress and shifted management of the stockpile from the Federal Emergency Management Agency to the Secretary of Defense. The Senate rejected an amendment to the authorization legisla-

tion that would have allowed the President to reduce stockpile reserves to $7.2 billion and the level of each material by 15%.

As a result of a general review of the Generalized System of Preferences (GSP) program, mandated by the Trade and Tariff Act of 1984, the United States removed imports of Brazilian silicon metal from the GSP's exemption list, placing a 5.3% duty on imports of silicon metal in the 99.0% to 99.7% purity category, effective July 1, 1987.

West Virginia gave a tax break to power companies that supply ferroalloy producers in that State. Under the new law, power companies were not subject to gross sales tax on power distributed to produce ferroalloys. The power companies were required to pass along the savings to the ferroalloy producers through rate reductions.

The Environmental Protection Agency (EPA) published revised particulate-emissions controls. The particulate-matter rules superseded earlier standards and required that smaller particles be captured by emission control equipment. EPA also published land disposal restrictions on a second group of chemicals mentioned in the 1984 amendments to the Resource Conservation and Recovery Act (RCRA). The group included eight metals, among which were chromium and nickel. RCRA requires that liquid wastes, including free liquids associated with any solid or sludge, be restricted from land disposal if they contain certain concentrations of the listed metals or their compounds. The EPA also set limits for hazardous materials in electric arc furnace dust that would be disposed of in landfills.

Table 1.—Government inventory of ferroalloys, December 31, 1987

(Thousand short tons)

Alloy	Stockpile grade	Nonstockpile grade	Total
Ferrochromium:			
High-carbon	537	1	538
Low-carbon	100	19	119
Ferrochromium-silicon	57	1	58
Ferrocolumbium (contained columbium)	3	2	5
Ferromanganese:			
High-carbon	705		705
Medium-carbon	29		29
Ferrotungsten (contained tungsten)	1	6	1
Silicomanganese	24		24

DOMESTIC PRODUCTION

Production and shipments of bulk ferroalloys (i.e., those containing chromium, manganese, and silicon) and metals overall increased 7% and 8%, respectively, compared with those of 1986. Producer stocks of most ferroalloy materials were down at yearend, owing to high demand from consuming industries.

Applied Industrial Minerals Corp. shut down its Kimball, TN, ferrosilicon plant early in the year, owing to competition from low-priced imports. SKW Alloys Inc. started silicon metal production in January, after completing the conversion of one of its ferrosilicon furnaces in Niagara Falls, NY. Universal Consolidated Co. purchased M. A. Hanna Co.'s previously closed ferronickel smelter in Riddle, OR, and announced plans to reactivate the facility to produce ferrosilicon in 1988.

Moore McCormack Resources Inc. completed the sale of Globe Metallurgical Inc., a silicon and ferrosilicon producer, to a management group backed by Lee Capital Corp., an investment banking firm based in Boston, MA. Globe planned to continue producing silicon metal, magnesium ferrosilicon, and 50% ferrosilicon at its facilities in Beverly, OH, and Selma, AL.

Foote Mineral Co. sold both of its ferrosilicon production facilities at the end of the year. The Graham, WV, plant, which had been closed since 1985, was purchased by an employee group under the name American Alloys Inc. The new company planned to start production of 50% ferrosilicon by March 1988 and possibly convert some of its capacity to silicon metal production later in the year. Keokuk Ferro-Sil Inc., a group formed by former Foote employees, purchased the Keokuk, IA, facility and planned to continue production of silvery pig iron and 50% ferrosilicon. Foote had sold its ferrovanadium production facility in Cambridge, OH, to Shieldalloy Corp. earlier in the year.

Estimated ferrous scrap consumption by the domestic ferroalloys industry was 280,000 tons in 1987 compared with 250,000 tons in 1986.

The Ferroalloys Association reported that its member companies consumed 4.5 billion kilowatt hours of electricity in 1987 compared with 4.2 billion kilowatt hours in 1986.

Table 2.—Ferroalloys[1] produced and shipped from furnaces in the United States

	1986				1987			
	Net production		Net shipments		Net production		Net shipments	
	Gross weight (short tons)	Alloy element contained (average percent)	Gross weight (short tons)	Value (thousands)	Gross weight (short tons)	Alloy element contained (average percent)	Gross weight (short tons)	Value (thousands)
Chromium alloys[2]	165,407	62	115,659	$87,624	117,634	61	126,423	$107,078
Chromium metal	(3)	100	(3)	(3)	(3)	100	(3)	(3)
Manganese alloys[4]	137,368	81	111,592	90,941	112,945	78	128,328	101,768
Manganese metal	(5)	100	(5)	(5)	(5)	100	(5)	(5)
Silicon alloys[6]	329,441	53	271,810	218,382	357,255	52	374,865	193,227
Silicon metal	123,893	99	126,077	148,797	149,428	99	149,713	186,713
Total[7]	686,109	XX	724,658	545,744	737,262	XX	779,689	588,651
Ferrocolumbium	W	65	W	W	(8)	65	(8)	(8)
Ferrophosphorus	58,147	24	53,758	7,161	40,188	23	40,642	6,171
Other[9]	72,109	XX	76,231	111,848	34,676	XX	51,686	123,669
Total[7]	130,256	XX	129,989	119,009	75,864	XX	92,328	129,840
Grand Total[7]	816,365	XX	854,627	664,753	813,126	XX	871,967	718,491

W Withheld to avoid disclosing company proprietary data, included with "Other." XX Not applicable.
[1]Does not include alloys consumed in the making of other ferroalloys.
[2]Includes ferrochromium, ferrochromium-silicon, chromium briquets, exothermic additives, and miscellaneous chromium alloys.
[3]Included with chromium alloys.
[4]Includes ferromanganese, fused-salt electrolytic low- and medium-carbon ferromanganese (mass ve manganese), and silicomanganese.
[5]Included with manganese alloys.
[6]Included with ferrosilicon and other miscellaneous silicon alloys.
[7]Data may not add to totals shown because of independent rounding.
[8]Included with "Other."
[9]Includes ferroaluminum, ferroboron and other complex boron additive alloys, ferromolybdenum, ferronickel, ferrotitanium, ferrotungsten, ferrovanadium, ferrozirconium, silvery pig iron, and other miscellaneous alloys.

Table 3.—Producers of ferroalloys in the United States in 1987

Producer	Plant location	Products[1]	Type of furnace
FERROALLOYS (EXCEPT FERROPHOSPHORUS)			
Affiliated Metals and Minerals Inc	New Castle, PA	FeMo, FeV	Metallothermic.
Aluminum Co. of America, Northwest Alloys Inc	Addy, WA	FeSi, Si	Electric.
AMAX Inc., Climax Molybdenum Co. Div	Langeloth, PA	FeMo	Metallothermic.
Applied Industrial Minerals Corp (AIMCOR)	Bridgeport, AL	FeSi	Electric.
Do	Kimball, TN	$FeSi_2$, other[2]	Do.
Ashland Chemical Co	Columbus, OH	FeB, FeCb, FeMo, FeTi, FeW, NiCb	Electric and metallothermic.
Cabot Corp	Revere, PA	FeCb	Metallothermic.
Cyprus Minerals Co., Duval Corp	Sahuarita, AZ	FeMo	Do.
Dow Corning Corp	Springfield, OR	Si	Electric.
Eikem A/S, Eikem Metals Co	Alloy, WV	Cr, FeB, FeCr, FeMn, FeSi, Mn, Si, SiMn, other[2]	Electric and electrolytic.
	Ashtabula, OH		
	Marietta, OH		
	Niagara Falls, NY		
Foote Mineral Co., Ferroalloys Div	Graham, WV[3]	FeSi, silvery pig iron, other[2]	Electric.
	Keokuk, IA[4]		
Hanna Mining Co., Silicon Div	Wenatchee, WA	FeSi, Si	Do.
Kerr-McGee Chemical Corp	Hamilton (Aberdeen), MS	Mn	Electrolytic.
Macalloy Corp	Charleston, SC	FeCr	Electric.
Metallurg Inc., Shieldalloy Corp	Cambridge, OH	Cr, FeAl, FeB, FeCb, FeTi, FeV, other[2]	Electric and Metallothermic.
	Newfield, NJ		
Moore McCormack Resources Inc., Globe Metallurgical Inc	Beverly, OH	FeCr, FeSi, Si	Electric.
	Selma, AL		
Ohio Ferro-Alloys Corp	Montgomery, AL	FeSi, Si	Do.
Reactive Metals and Alloys Corp	West Pittsburg, PA	FeAl, FeB, FeTi, other[2]	Do.
Reading Alloys Inc	Robesonia, PA	FeCb, FeV	Metallothermic.

See footnotes at end of table.

Table 3.—Producers of ferroalloys in the United States in 1987 —Continued

Producer	Plant location	Products[1]	Type of furnace
FERROALLOYS (EXCEPT FERROPHOSPHORUS)—Continued			
Reynolds Metals Co	Sheffield, AL	Si	Electric
SEDEMA S.A., Chemetals Inc	Baltimore, MD	FeMn	Electric and electrolytic
SKW Alloys Inc	Calvert City, KY	FeCr, FeCrSi	Electric
	Niagara Falls, NY	FeSi	Do
Strategic Minerals Corp. (STRATCOR):			
U.S. Vanadium Corp	do	FeV, FeW	Do
U.S. Tungsten Corp	Albany, OR	FeCb	Metallothermic
Teledyne Inc., Teledyne Wah Chang, Albany Div	Washington, PA	FeB, FeMo	Electric and metallothermic
Union Oil Co. of California, Molycorp Inc	Riddle, OR	FeNi, FeSi	Electric
Universal Consolidated Co., Nickel Mountain Resources			
FERROPHOSPHORUS			
FMC Corp., Industrial Chemical Div	Pocatello, ID	FeP	Do
Monsanto Co., Monsanto Industrial Chemicals Co	Soda Springs, ID	do	Do
Occidental Petroleum Corp., Hooker Chemical Co., Industrial Chemicals Group	Columbia, TN	do	Do
Stauffer Chemical Co., Industrial Chemical Div	Mount Pleasant, TN	do	Do
	Silver Bow, MT		

[1]Cr, chromium metal; FeAl, ferroaluminum; FeB, ferroboron; FeCb, ferrocolumbium; FeCr, ferrochromium; FeCrSi, ferrochromium-silicon; FeMn, ferromanganese; FeMo, ferromolybdenum; FeNi, ferronickel; FeP, ferrophosphorus; FeSi, ferrosilicon; FeTi, ferrotitanium; FeV, ferrovanadium; FeW, ferrotungsten; FeZr, ferrozirconium; Mn, manganese metal; Si, silicon metal; SiMn, silicomanganese.
[2]Includes specialty silicon alloys, zirconium alloys, and miscellaneous ferroalloys.
[3]Sold to American Alloys Inc. at yearend.
[4]Sold to Keokuk Ferro-Sil Inc. at yearend.

CONSUMPTION AND USES

Overall demand for ferroalloys as additives and alloying elements increased in 1987, owing partly to an 8% increase in raw steel production. Other major consuming markets, such as the stainless steel and ferrous castings industries, also demanded more ferroalloys than in 1986.

USX Corp., a major consumer of ferroalloys, reopened steelmaking operations that had been shut down for about half of 1986 because of a labor dispute.

Table 4.—Reported U.S. consumption of ferroalloys as additives in 1987, by end use[1]

(Short tons of alloys unless otherwise specified)

End use	FeMn	SiMn	FeSi	FeTi	FeP	FeB
Steel:						
Carbon	313,009	81,812	[2]57,750	784	8,491	319
Stainless and heat-resisting	[2]17,784	3,770	[2]74,769	2,457	W	32
Other alloy	[2]69,541	[2]22,815	[2]52,522	358	960	323
Tool	[2]369	[3]	2,061	[3]		
Unspecified	1,610	416	10,753	5		
Total	402,313	108,813	197,795	3,604	9,361	674
Cast irons	[4]8,839	2,555	202,914	W	2,207	W
Superalloys	154	W	[4]271	689		W
Alloys (excluding alloy steels and superalloys)	18,373	W	[4]47,063	320	109	71
Miscellaneous and unspecified	5,269	3,177	73,792	40	7	88
Total consumption	434,948	114,545	521,835	4,653	11,684	833
Percent of 1986	109	111	104	109	107	111

W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."
[1]FeMn, ferromanganese including spiegeleisen and manganese metal; SiMn, silicomanganese; FeSi, ferrosilicon including silicon metal, silvery pig iron, and inoculant alloys; FeTi, ferrotitanium; FeP, ferrophosphorus; FeB, ferroboron including other boron materials.
[2]Part included with "Steel: Unspecified."
[3]Included with "Steel: Unspecified."
[4]Part included with "Miscellaneous and unspecified."

Table 5.—Reported U.S. consumption of ferroalloys as alloying elements in 1987, by end use[1]

(Short tons of contained elements unless otherwise specified)

End use	FeCr	FeMo	FeW	FeV	FeCb	FeNi
Steel:						
Carbon	[2]4,333	132	—	1,197	807	
Stainless and heat-resisting	205,278	252	71	65	466	16,677
Other alloy	[2]25,778	980	31	2,152	827	346
Tool	[2]2,406	W	168	465	[3]	—
Unspecified	[3]	[3]	—	—	6	—
Total[4]	235,795	1,364	270	3,880	2,100	17,023
Cast irons	[5]9,578	637	[3]	25	—	314
Superalloys	[5]9,362	50	W	10	442	—
Alloys (excluding alloy steels and superalloys)	[5]1,892	168	W	[5]691	8	61
Miscellaneous and unspecified	3,995	310	10	48	40	20
Total consumption[4]	254,622	2,530	279	4,653	2,589	17,418
Percent of 1986	121	124	135	108	104	131

W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."
[1]FeCr, ferrochromium including other chromium ferroalloys and chromium metal; FeMo, ferromolybdenum including calcium molybdate; FeW, ferrotungsten; FeV, ferrovanadium including other vanadium-carbon-iron ferroalloys; FeCb, ferrocolumbium including nickel columbium; FeNi, ferronickel.
[2]Included with "Steel: Unspecified."
[3]Included with "Miscellaneous and unspecified."
[4]Data may not add to totals shown because of independent rounding.
[5]Part included with "Miscellaneous and unspecified."

Table 6.—Reported stocks of ferroalloys held by producers and consumers in the United States, December 31

(Short tons)

	Producer		Consumer		Total	
	1986 (gross weight)	1987 (gross weight)	1986 (gross weight)	1987 (gross weight)	1986 (gross weight)	1987 (gross weight)
Chromium alloys[1]	14,105	5,687	31,790	24,900	45,895	30,587
Manganese alloys[2]	W	W	W	W	[r]109,032	64,803
Silicon alloys[3]	140,788	81,400	21,264	20,375	162,052	101,775
Ferroboron[4]	137	127	217	252	354	379
Ferrophosphorus	63,539	25,326	1,386	1,307	64,910	26,663
Ferrotitanium	W	W	609	773	609	773
Total	218,569	112,540	55,266	47,607	382,852	224,980
	1986 (contained element)	1987 (contained element)	1986 (contained element)	1987 (contained element)	1986 (contained element)	1987 (contained element)
Ferrocolumbium[5]	W	W	W	W	W	W
Ferromolybdenum[6]	369	742	309	277	1,218	1,019
Ferronickel			1,028	NA	1,028	NA
Ferrotungsten	W	W	29	68	29	68
Ferrovanadium[7]	W	W	314	372	314	372
Total	369	742	1,680	717	2,589	1,459

[r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Includes ferrochromium, ferrochromium-silicon, other chromium alloys, and chromium metal.
[2]Includes ferromanganese, silicomanganese, and manganese metal.
[3]Includes ferrosilicon, miscellaneous silicon alloys, and silicon metal.
[4]Consumer totals include other boron materials.
[5]Consumer totals include nickel columbium.
[6]Consumer totals include calcium molybdate.
[7]Includes other vanadium-iron-carbon ferroalloys.

PRICES

Published prices for most ferroalloys rose in 1987 owing to increasing demand by major consuming industries and tightening supplies. The average posted price for most imported bulk ferroalloys was higher in 1987 compared with that of 1986; for example, by 10% to 43.5 cents per pound of chromium for charge chrome containing 50% to 55% chromium, by 4% to 85.92 cents per pound of chromium for low-carbon ferrochromium (LC-FeCr), by 7% to $336.95 per long ton of alloy for standard 78% ferromanganese, by 7% to 33.76 cents per pound of manganese for medium-carbon ferromanganese, by 8% to 18.7 cents per pound of alloy for silicomanganese, by 9% to 37.76 cents per pound of silicon for 50% ferrosilicon, and by 10% to 36.15 cents per pound of silicon for 75% ferrosilicon. The average annual price for imported charge chrome containing 60% to 65% chromium fell slightly to 42.38 cents per pound of chromium. Posted average annual prices for comparable domestically produced alloys in 1987 were mixed compared with those of 1986. The average prices for 50% and 75% ferrosilicon rose 3% and 1%, respectively, while those for medium-carbon ferromanganese and charge chrome containing 66% to 70% chromium fell slightly. Most other average prices remained unchanged.

Alloy	Yearend price[1]	
	1986	1987
Charge chromium (66% to 70%)	$0.54	$0.52
Low-carbon ferrochromium, 0.02% maximum carbon (Simplex)	1.00	1.10
Standard 78% ferromanganese, per long ton of alloy[2]	305.00	280.00
Ferromolybdenum, dealer export	3.65	3.93
Ferrosilicon, 50%	40	47
Ferrosilicon, 75%	40	47

[1]Per pound contained, except as noted otherwise. If range of prices was quoted, the lowest price is shown.
[2]Prices for imported material. List price for domestic material suspended on June 28, 1984.

Source: Metals Week.

FOREIGN TRADE

The trade deficit for ferroalloys decreased from $505 million in 1986 to $490 million in 1987. A trade surplus of $13 million was recorded for ferroalloy metals in 1987 compared with a deficit of $21 million in 1986.

Imports for consumption of ferroalloys and ferroalloy metals were supplied by 37 countries and decreased nearly 7% compared with those of 1986. Geographic sources and their respective share of total U.S. imports of ferroalloy materials were Africa, 40%; Europe, 31%; the Western Hemisphere, 25%; Asia, 2%; and Oceania, 2%. The Republic of South Africa continued to be the United States main source of ferroalloy materials overall, accounting for 37% of total imported ferroalloys and metals. Of the total imported chromium and manganese alloys, the Republic of South Africa supplied 66% and 38%, respectively. The second leading suppliers of these materials were Turkey (15%) for chromium alloys and France (22%) for manganese alloys. The Republic of South Africa accounted for 100% of the unwrought manganese metal imports, while the United Kingdom supplied 34% of the imported chromium metal to the United States. Colombia and the Dominican Republic were the leading suppliers of ferronickel, accounting for 56% and 19% of U.S. ferronickel imports, respectively. Imports of ferrosilicon overall increased to a record-high amount, while those of 75% ferrosilicon, typically the largest share, decreased by 7%. The principal sources of ferrosilicon were Brazil, 33%; Norway, 15%; the U.S.S.R., 13%; Canada, 11%; and Venezuela, 11%. Imports of silicon metal overall decreased by 10%, owing mostly to a significant decrease in shipments from Brazil. The principal sources of silicon metal were Canada, 32%; Argentina, 17%; and Yugoslavia, 16%.

The United States exported ferrosilicon to 24 countries in 1987. Over one-half of that material was shipped to Canada. Nearly 70% of U.S. silicon metal exports went to Japan, with the remainder distributed among 33 other countries. Manganese metal was exported to 27 countries, with Japan and Canada receiving the largest shares.

Table 7.—U.S. exports of ferroalloys and ferroalloy metals

Alloy	1985		1986		1987	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ferroalloys:						
Ferrocerium and alloys	28	$314	37	$319	90	$653
Ferrochromium and ferrochromium-silicon	16,762	7,538	6,035	5,693	4,568	5,730
Ferromanganese	6,927	4,762	4,323	2,650	2,851	7,144
Silicomanganese	3,089	156	2,004	687	697	493
Ferromolybdenum	631	2,698	166	928	81	605
Ferrophosphorus	49,674	5,776	38,377	4,393	34,699	4,334
Ferrosilicon	12,970	12,671	11,331	8,396	15,049	11,647
Ferrovanadium	454	4,791	513	4,647	436	4,081
Ferroalloys, n.e.c.	14,408	24,581	10,029	11,561	19,073	14,938
Total ferroalloys[1]	98,533	63,417	72,814	39,184	77,543	44,626
Metals:						
Chromium	229	2,964	321	2,972	415	4,670
Manganese	5,142	7,242	5,146	7,892	5,775	9,748
Silicon	2,120	61,647	5,378	65,157	9,247	106,213
Total ferroalloy metals[1]	7,504	71,854	10,845	76,020	15,437	120,631
Grand total[1]	106,037	135,271	83,660	115,204	92,980	165,257

[1]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

Table 8.—U.S. imports for consumption of ferroalloys and ferroalloy metals

Alloy	1986			1987		
	Gross weight (short tons)	Content (short tons)	Value (thousands)	Gross weight (short tons)	Content (short tons)	Value (thousands)
Chromium alloys:						
Ferrochromium containing 3% or more carbon	548,443	198,168	$139,983	283,613	158,505	$112,546
Ferrochromium containing less than 3% carbon	39,969	25,582	32,707	42,246	26,940	37,723
Ferrochromium-silicon	9,221	3,532	5,743	8,356	3,117	4,920
Total chromium alloys[1]	597,633	227,282	178,432	334,215	188,562	155,189
Manganese alloys:						
Ferromanganese containing 1% or less carbon	18,130	16,179	16,782	20,132	17,852	17,203
Ferromanganese containing more than 1% to 4% carbon	66,225	54,068	28,483	50,442	41,359	22,951
Ferromanganese containing more than 4% carbon	311,296	240,809	75,216	297,104	230,166	73,476
Silicomanganese	198,646	[2]131,425	58,839	191,418	[2]124,315	58,461
Spiegeleisen	213	[3]	113	209	[3]	168
Total manganese alloys[1]	594,510	442,472	179,434	559,305	413,692	172,260
Silicon alloys (ferrosilicon):						
8% to 30% silicon	103	19	103	3,675	607	1,132
30% to 60% silicon, over 2% magnesium	3,797	1,741	2,781	6,965	3,252	5,286
30% to 60% silicon, n.e.c.	49,680	24,644	16,717	58,747	29,076	22,456
60% to 80% silicon, over 3% calcium	11,227	6,971	9,846	15,191	10,019	11,267
60% to 80% silicon, n.e.c.	156,922	117,629	70,221	145,855	109,531	68,410
80% to 90% silicon						
Over 90% silicon	1,892	1,800	910	226	214	200
Total silicon alloys[1]	223,031	152,795	100,578	230,658	152,698	108,749

See footnotes at end of table.

Table 8.—U.S. imports for consumption of ferroalloys and ferroalloy metals—Continued

Alloy	1986			1987		
	Gross weight (short tons)	Content (short tons)	Value (thousands)	Gross weight (short tons)	Content (short tons)	Value (thousands)
Other ferroalloys:						
Ferrocerium and other cerium alloys	104	(3)	$1,143	122	(3)	$1,704
Ferromolybdenum	940	500	1,670	1,466	1,142	4,041
Ferronickel	37,902	13,656	18,972	45,781	21,106	37,161
Ferrophosphorus	(3)	(3)	2			
Ferrotitanium and ferrosilicon titanium	681	(3)	1,421	1,121	(3)	2,501
Ferrotungsten and ferrosilicon tungsten	122	92	1,119	329	231	1,775
Ferrovanadium	726	594	6,425	442	342	3,771
Ferrozirconium	503	(3)	473	417	(3)	780
Ferroalloys, n.e.c.[5]	3,190	(3)	17,962	3,949	(3)	22,749
Total other ferroalloys[4]	44,929	XX	56,187	54,259	XX	96,379
Total ferroalloys[4]	1,259,202	XX	544,032	1,178,414	XX	524,377
Metals:						
Chromium	4,485	(3)	21,847	4,578	(3)	23,936
Manganese	9,674	(3)	9,603	8,901	(3)	9,614
Silicon (96% to 99% silicon)	8,836	(3)	8,387	2,662	(3)	2,594
Silicon (99% to 99.7% silicon)	31,260	31,006	31,307	33,443	33,144	32,960
Silicon (over 99.7% silicon)	732	(3)	25,278	428	(3)	16,714
Total ferroalloy metals[4]	55,010	XX	96,631	50,371	XX	110,998
Grand total[4]	1,314,212	XX	641,263	1,228,690	XX	641,375

XX Not applicable.
[1]Data may not add to totals shown because of independent rounding.
[2]Manganese content only.
[3]Not recorded.
[4]Less than 1/2 unit.
[5]Principally ferrocolumbium.

Source: Bureau of the Census.

WORLD REVIEW

Demand for ferroalloys increased in many countries compared with that of 1986. Prices for ferroalloys rose steadily as supplies tightened, and a continuing production shift from traditional suppliers to developing countries was observed as plant closings occurred in some industrialized countries. Overall production was little changed.

The European Economic Community (EEC) imposed a 6.2% import duty on Yugoslav ferrosilicon and announced that it would make permanent a provisional antidumping duty of $58 per ton against 75% ferrosilicon coming into Europe from Brazil. The EEC also imposed a $58 per ton antidumping duty against ferrosilicon from the U.S.S.R. after imports were found to be entering Western Europe at significantly reduced prices.[2] H-C-FeCr producers inside the EEC asked the European Commission to investigate possible dumping of that material by Finland.

The United States threatened to impose additional import duties on silicon-containing materials from Brazil in retaliation to Brazil's strict import regulations on U.S. computer software.[3]

Albania.—Albania planned to double ferrochromium production capacity as part of its 1986-90 5-year plan.

Argentina.—Silarsa S.A., a new company formed by Stein Ferroalloys S.A. and two units of the A. Johnson & Co. Group of the United States, planned a new joint venture to produce 16,000 tons per year of silicon metal, primarily for sale in the United States. Startup was scheduled for 1988.[4] Electrometalurgica Andina S.A. increased silicon metal production capacity to 11,000 tons per year by activating a new 12-megavolt-ampere (MV•A) furnace at its San Juan facility.[5]

Australia.—The country's first silicon metal smelter, a joint venture between Pioneer Concrete Ltd. and French metals

producer Pechiney, started production in Tasmania. The plant's single 14-megawatt furnace is capable of producing 12,000 tons per year.[8] Agnew Clough and the Australian Industry Development Corp. established a trust to build a 25,000-ton-per-year silicon metal production facility in the Wundowie area. Total cost of the project was projected to be A$70 million with construction beginning in 1988.[9] Tasmanian Electro Metallurgical Co. Pty. Ltd. raised the ratings of two electric furnaces to 29 MV•A and that of a third to 36 MV•A, upgrading their total capacity to about 200,000 tons per year for HC-FeMn or 120,000 tons per year for silicomanganese.

Brazil.—Cia. de Ferro-Ligas da Bahia S.A., Brazil's only ferrochromium producer, experienced power rationing, which held back production. Production of some other ferroalloys, such as HC-FeMn, 50% ferrosilicon, and a number of specialty alloys, also decreased owing to electric power problems from a prolonged drought. However, production of ferrosilicon overall (300,000 tons) and silicon metal (44,000 tons) both increased 8% compared with that of 1986.

Currently the world's fifth largest ferroalloy producer overall, Brazil continued to capture more of the world market for silicon products as exports of ferrosilicon and silicon metal increased nearly 25%.

Comargo Correa Metais S.A. neared completion on the construction of its new silicon metal production facility. The plant consisted of four 18-MV•A furnaces with a combined capacity of 35,000 tons per year. Startup of the facility was scheduled for April 1988. The company also planned for a second phase of the project with an equal amount of capacity to be brought on-line in 1990.[9] Bozel Mineração e Ferroligas S.A. started a new 15-MV•A silicon metal furnace in Minas Gerais with the capacity to produce 9,000 tons annually.[9] Several Brazilian companies planned ferrosilicon capacity expansions, including Cia. de Cimento Portland Maringa, which completed construction of a 15-MV•A furnace at its ferroalloy plant in São Paulo.[10]

Cia. Vale do Rio Doce (CVRD) signed an agreement with Prometal Produtos Metalúrgicos S.A. to produce ferromanganese at Paraupebas near the Azul manganese mine. CVRD would retain 40% of the ownership, with Prometal holding the remaining 60% and the U.S.S.R. supplying 50% of the $100 million investment in equipment. The U.S.S.R. was to be repaid over a period of 12 years with one-half of the plant's output, aproximately 80,000 tons per year.

Canada.—Timminco Ltd.'s Chromasco Div. shut down two of three furnaces at its facility in Beauharnois. The company had been producing ferromanganese and ferrosilicon, but future plans include only ferrosilicon production.

China.—Silicon metal producers in China, after more than doubling their production capacity over the past several years, continued to increase exports and captured nearly one-half of the Japanese market. Exports of silicon metal to Japan were 61,704 tons, a 68% increase over those of 1986. China also significantly increased its exports of silicon metal to the United States and Western Europe. China increased production of ferrosilicon to meet increasing demand from its domestic steel industry while further expanding into world markets. Ferrosilicon shipments to Japan were nearly five times the amount reported in 1986. In January, the Chinese Government lifted a 30% export duty on ferrosilicon. However, during the course of the year, strict export controls were being considered as a means of ensuring material for domestic needs.[11]

China Metallurgical Import and Export Corp. and Australia's Broken Hill Pty. Co. Ltd. agreed to study the feasibility of establishing a 66,000-ton-per-year manganese ferroalloy plant at Yichang.[12]

Dominican Republic.—The ferronickel producer, Falconbridge Dominicana C. por A., suspended shipments in December owing to a prohibitive duty on mineral exports imposed by the Dominican Government.

France.—Pechiney Electrometallurgie considered a plan to switch production at its Dunkirk plant from ferrosilicon to either silicomanganese or charge chrome. The company decided to close its St. Beron facility owing to high energy costs, labor costs, and the availability of low-cost imports from Brazil and China. Pechiney also halted production of ferrovanadium at its Chedde plant. A decision on future production at its Laudon ferrosilicon plant was pending.[13] Ferroaleaciones Españolas S.A. of Spain started construction of a new 16,500-ton-per-year ferrochromium plant at Dunkirk. Completion was expected in 1988.[14]

Germany, Federal Republic of.—Elektrowerk Weisweiler GmbH resumed production of LC-FeCr, after a temporary stoppage owing to low market demand.

Greece.—Société Minière et Metallur-

gique de Larymna S.A. continued production of ferronickel despite earlier plans to restucture and start ferrochromium production.[15]

India.—Bulk ferroalloy (i.e., ferrochromium, ferromanganese, and ferrosilicon) production increased 10% during fiscal year 1986-87, despite electric power shortages caused by the country's worst drought in nearly 100 years. Increased demand from the stainless steel industry fueled a 40% increase in H-C-FeCr output and resulted in one company's (Ferro Alloys Corp. Ltd.) temporary suspension of exports. Indian Metals and Ferro Alloys Ltd. continued construction of a 50,000-ton-per-year ferrochromium plant and expected completion sometime in 1988. One of the country's major ferrosilicon producers, VBC Alloy Co., announced plans to diversify into specialty ferroalloy products.[16]

Japan.—Awamura Metal Industry Co. Ltd. and Kurimoto Iron Works Ltd. both halted ferrochromium production, which resulted in lower overall production for the year. However, increased ferrochromium imports replaced lost production. Stainless steel production exceeded that of each of the preceding 5 years and created an increased demand for ferrochromium. Consuming industries (i.e., iron and steel, chemical, and aluminum) also demanded more ferrosilicon and silicon metal than in 1986. The Japanese Ferroalloy Association reported that overall production of ferrosilicon dropped more than 25% in 1987 to 87,980 tons. However, a significant increase in imports again helped close the demand gap. Japanese silicon metal imports also increased nearly 10% compared with those of 1986. Overall production of manganese ferroalloys decreased nearly 20% to about about 467,000 tons. Nippon Mining Co. annouced that it would close its 10,000-ton-per-year ferronickel smelter owing to excessive supply.[17]

Norway.—Elkem A/S, the world's largest silicon metal producer, announced that it would temporarily cut production at its Meraker plant from 35,000 to 19,000 tons per year owing to market conditions. Despite the cut, Elkem's share of world silicon metal production was expected to remain above 20%.[18] Tinfos Jernverk A/S announced the permanent closure of its ferrosilicon and silicon metal plant at Notodden. Production at the Notodden plant, which had a combined ferrosilicon-silicon capacity of over 90,000 tons per year, was stopped at the end of 1986.[19]

Portugal.—Cia. Portuguesa de Fornos Electricos S.A.R.L.'s Nelas ferrosilicon production facility, which was shut down in late 1986, remained closed pending a court decision on the company's future viability. High electrical power costs and totally depleted stocks were stated as Fornos' major obstacles to reactivating the plant.[20]

South Africa, Republic of.—Batlhako Ferrochrome (Pty.) Ltd. started production at its new 27,500-ton-per-year ferrochromium plant in Bophuthatswana near the Ruighoek Mine. Marketing is to be handled by South African Manganese Amcor Ltd.

Middleburg Steel and Alloys Ltd. (MSA) modernized its L-C-FeCr ferrochromium production facilities at Middleburg, Transvaal. As a result of the modernization, MSA increased L-C-FeCr production at Middleburg from about 36,000 to about 50,000 tons per year. MSA also planned to increase the H-C-FeCr production capacity of its direct-current plasma arc furnace at Krugersdrop, Transvaal, from 18,000 to 40,000 tons per year.

Chromcorp Technology (Pty.) Ltd. planned to build a 120,000-ton-per-year H-C-FeCr plant near Rustenburg, Transvaal. The plant will consist of two 30-MV•A furnaces and is expected to cost $26 million.

Rand Carbide Ltd. decided to cut ferrosilicon production by 20%, owing to an appreciation of the rand on exchange markets. The company said it would concentrate on selling its remaining production locally.[21]

Spain.—Facing high labor and power costs, ferroalloy producers entered rationalization talks with the Government. Industry sources expected the talks to result in production cutbacks and possible plant closures.[22]

Swaziland.—Swazi Chrome planned a new 55,000-ton-per-year ferrochromium production facility. Construction was expected to begin once a plan for power rates could be negotiated with the Swazi Government.

Sweden.—SwedeChrome AB started production of H-C-FeCr at its Malmö facility. The company expected to reach full production, 86,000 tons per year, sometime in 1988. Ferroalloy producer, Vargön Alloys AB, was bought from Fides of Switzerland by a group of Vargon's management and Mellanfondon, a Swedish Wage Earner Fund. Company officials did not expect any significant changes in output.[23]

Turkey.—Etibank neared completion of

additional H-C-FeCr capacity at its Elazig plant. The additional 55,000 tons per year will double capacity at Elazig and was all slated for export.[4]

U.S.S.R.—Owing to increased demand from its domestic steel industry, the Soviet Union was believed to be planning a 20% cut in ferrosilicon exports. Exports of Soviet ferrosilicon to the United States and Japan had significantly increased over the past several years.[5]

Venezuela.—C.V.G. Ferrosilicon de Venezuela C.A. (FESILVEN) planned to increase its ferrosilicon production capacity from 65,000 to 95,000 tons by 1988. FESILVEN also began the initial planning of a silicon metal project.[6]

Yugoslavia.—Hek Jugohrom completed the conversion of a 24-MV•A furnace from H-C-FeCr to ferrosilicon production and planned a similar conversion for a 14-MV•A furnace. On the other hand, Dalmacija Carbide and Ferro Alloy Works switched production of one furnace from ferrosilicon to H-C-FeCr, adding about 35,000 tons of capacity.

Zimbabwe.—Zimbabwe Mining and Smelting Co. (Zimasco) started construction of a new induction remelting furnace that was expected to increase its H-C-FeCr capacity about 10% to 175,000 tons per year. Zimasco also planned to restart a 15,000-ton-per-year H-C-FeCr furnace, which had been held in reserve for use when other furnaces were under repair. Zimbabwe Alloys Ltd. converted a furnace from ferrochromium-silicon to H-C-FeMn production.

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[1]Personal scientist, Branch of Ferrous Metals.
[2]Metal Bulletin (London). No. 7240, Dec. 9, 1987, p. 19.
[3]American Metal Market. V. 95, No. 232, Dec. 1, 1987, p. 1.
[4]Metal Bulletin (London). No. 7159, Feb. 10, 1987, p. 9.
[5]American Metal Market. V. 95, No. 155, Aug. 11, 1987, p. 1.
[6]Metal Bulletin (London). No. 7242, Dec. 7, 1987, p. 17.
[7]———. No. 7155, Jan. 27, 1987, p. 11.
[8]———. No. 7236, Nov. 16, 1987, p. 13.
[9]The Tex Report. V. 19, No. 4457, June 12, 1987, p. 7.
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[11]———. V. 19, No. 4582, Dec. 11, 1987, p. 10.
[12]Skillings' Mining Review. V. 76, No. 10, Mar. 7, 1987, p. 6.
[13]Page 19 of work cited in footnote 6.
[14]Metal Bulletin (London). No. 7157, Feb. 3, 1987, p. 15.
[15]Metals Week. V. 58, No. 50, Dec. 14, 1987, p. 1.
[16]Metal Bulletin Monthly (London). No. 203, Nov. 1987, p. 11.
[17]American Metal Market. V. 95, No. 140, July 21, 1987, p. 2.
[18]Metal Bulletin (London). No. 7224, Oct. 5, 1987, p. 9.
[19]The Tex Report. V. 19, No. 4392, Mar. 10, 1987, p. 4.
[20]Metal Bulletin (London). No. 7247, Dec. 24, 1987, p. 11.
[21]The Tex Report. V. 19, No. 4411, Apr. 6, 1987, p. 2.
[22]Metal Bulletin (London). No. 7227, Oct. 15, 1987, p. 17.
[23]———. No. 7216, Sept. 7, 1987, p. 15.
[24]———. No. 7224, Sept. 24, 1987, p. 17.
[25]———. No. 7244, Dec. 14, 1987, p. 14.
[26]Page 11 of work cited in footnote 4.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1]

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[p]
Albania: Electric furnace, ferrochromium[e]	39	44	47	51	51
Argentina: Electric furnace:					
Ferromanganese	28	26	26	22	22
Silicomanganese	13	13	8	14	13
Ferrosilicon	17	22	21	25	24
Other	[4]	4	5	6	6
Total	60	67	60	67	65
Australia: Electric furnace:[5]					
Ferromanganese	59	[r]78	78	67	[e]67
Silicomanganese	22	[r]35	28	[e]25	[e]47
Ferrosilicon	21	[r]20	21	[e]17	21
Total[7]	101	[r]133	127	109	125
Austria: Electric furnace, undistributed	15	14	13	13	13
Belgium: Electric furnace, ferromanganese[e]	96	102	99	96	96
Brazil: Electric furnace:					
Ferromanganese	144	117	149	181	[e]171
Silicomanganese	197	205	193	196	[e]207
Ferrosilicon	[r]163	[r]167	200	240	[e]255
Silicon metal	23	30	32	41	[e]44
Ferrochromium	85	138	140	121	[e]116
Ferrochromium-silicon	6	8	10	16	[e]9
Ferronickel	[r]33	[r]37	37	45	[e]39
Other	[r]47	[r]60	68	68	[e]67
Total[7]	[r]658	[r]762	830	894	[e]908
Bulgaria: Electric furnace:					
Ferromanganese[e] [8]	33	34	35	35	34
Ferrosilicon[e]	19	17	15	17	17
Other[e]	1	1	1	1	1
Total[7]	53	52	50	53	52
Canada: Electric furnace:[e]					
Ferromanganese[8]	118	128	130	139	141
Ferrosilicon	[r]94	88	93	97	99
Silicon metal	[r]28	28	28	29	30
Total[7]	[r]239	244	250	265	270
Chile: Electric furnace:[e]					
Ferromanganese	6	5	7	7	7
Silicomanganese	NA	NA	1	2	2
Ferrosilicon	5	7	5	4	4
Other	2	2	1	2	2
Total[7]	13	15	14	14	14
China: Furnace type unspecified:[e] [9]					
Ferromanganese[5]	540	540	540	[r]660	720
Ferrosilicon	215	215	215	[r]220	250
Silicon metal	24	24	24	[r]30	50
Ferrochromium[10]	130	130	130	130	140
Other[11]	80	80	80	80	110
Total[7]	990	990	990	[r]1,120	1,270
Colombia: Electric furnace:[e] [12]					
Ferrosilicon	1	1	1	1	1
Ferronickel	36	47	33	51	57
Total	37	48	34	52	58
Czechoslovakia: Electric furnace:					
Ferromanganese[e] [8]	103	96	103	101	101
Ferrosilicon[e]	33	[r]31	[r]33	33	33
Silicon metal[e]	5	4	5	6	6
Ferrochromium[e]	28	26	28	28	28
Other[e] [13]	10	9	10	9	9
Total[7]	179	166	177	[r]176	176
Dominican Republic: Electric furnace, ferronickel	58	71	76	64	[e]96
Egypt: Electric furnace, ferrosilicon	7	8	[e]8	8	8
Finland: Electric furnace, ferrochromium	65	65	147	147	148

See footnotes at end of table.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1] —Continued

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[e]
France:					
Blast furnace:					
Spiegeleisen[e]	1	1	1	1	1
Ferromanganese	297	302	302	302	300
Electric furnace:					
Silicomanganese[13]	36	38	26	24	24
Ferrosilicon	212	226	233	216	216
Silicon metal	72	78	r73	r77	77
Ferrochromium[15]	22	23	1	r1	1
Other[14]	117	121	107	85	83
Total[r]	757	869	793	707	703
German Democratic Republic: Electric furnace:					
Ferromanganese[e 8]	r70	r69	69	73	73
Ferrosilicon[e]	30	r30	28	29	29
Silicon metal[e]	4	4	4	4	4
Ferrochromium[e]	r21	21	21	23	23
Other[e 11]	20	r17	17	17	17
Total[r]	r141	r137	137	139	139
Germany, Federal Republic of:					
Blast furnace:					
Ferromanganese[e]	118	203	113	r206	159
Ferrosilicon[e]	44	57	47	r56	54
Electric furnace:					
Ferromanganese[e]	19	r24	r28	r29	32
Ferrosilicon[e]	34	r39	r41	r37	44
Ferrochromium[e]	42	r50	r57	r66	61
Other[e 11]	46	r60	r62	r67	60
Total[r]	321	r513	r414	560	490
Greece: Electric furnace:					
Ferrochromium	20	46	39	42	r46
Ferronickel[e]	55	58	60	r51	46
Total[r]	75	84	100	94	92
Hungary: Electric furnace:[e]					
Ferrosilicon	11	10	10	10	10
Silicon metal	2	2	2	2	2
Other	2	2	2	2	2
Total	15	14	14	14	14
Iceland: Electric furnace: ferrosilicon	75	67	67	73	73
India: Electric furnace:					
Ferromanganese	106	134	180	187	190
Silicomanganese	58	65	r75	r71	75
Ferrosilicon	54	56	44	55	55
Silicon metal[e]	4	r5	5	4	4
Ferrochromium	89	91	75	93	93
Ferrochromium-silicon	2	3	14	r11	13
Other	r4	r4	r1	r1	1
Total[r]	268	283	316	362	358
Indonesia: Electric furnace: ferronickel	35	25	26	25	17
Italy: Electric furance:					
Ferromanganese	69	56	19	r76	28
Silicomanganese	81	80	71	r68	66
Ferrosilicon	57	78	80	r62	51
Silicon metal[e]	15	15	15	12	13
Ferrochromium	13	14	64	r64	22
Other[13]	47	56	17	r31	30
Total[r 15]	240	299	256	r317	211

See footnotes at end of table.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1] —Continued

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[p]
Japan: Electric furnace:					
Ferromanganese	429	555	487	396	[r]366
Silicomanganese	245	257	209	164	[r]191
Ferrosilicon	174	169	160	118	[r]81
Ferrochromium[10]	[r]328	[r]350	375	309	[r]291
Ferronickel	199	239	250	221	[r]224
Other[16]	[r]12	[r]14	14	11	[r]9
Total[7]	1,387	1,564	1,501	1,218	[r]1,073
Korea, North: Furnace type unspecified[e 8]					
Ferromanganese[5]	77	77	77	77	77
Ferrosilicon	33	33	33	33	33
Other[11]	22	22	22	22	22
Total	132	132	132	132	132
Korea, Republic of: Electric furnace:					
Ferromanganese	58	65	68	59	[r]64
Ferrosilicon	36	39	38	34	[r]14
Other	48	55	60	73	[r]100
Total[7]	142	159	167	167	[r]178
Mexico: Electric furnace:					
Ferromanganese	155	177	169	172	[r]178
Silicomanganese	46	46	43	67	[r]68
Ferrosilicon	27	25	30	19	[r]20
Ferrochromium	3	8	7	3	[r]7
Other	2	2	3	2	[r]1
Total[7]	232	258	253	263	[r]294
New Caledonia: Electric furnace, ferronickel[e]	193	125	155	[r]144	127
Norway: Electric furnace:					
Ferromanganese	312	314	237	226	269
Silicomanganese	215	310	267	274	287
Ferrosilicon	407	482	425	389	397
Silicon metal[e]	[r]87	100	112	110	110
Ferrochromium[e]	4	4			
Ferrochromium-silicon[e]	(4)	(4)			
Other[e 14]	7	7	3	3	3
Total[7]	1,028	1,215	1,045	908	1,066
Peru: Electric furnace:					
Ferromanganese	(4)			(4)	(4)
Ferrosilicon	(4)			(4)	(4)
Total[7]	(4)			1	1
Philippines: Electric furnace:					
Ferrosilicon[e]	22	20	22	22	
Ferrochromium	30	53	56	[r]61	
Total	52	73	78	[r]83	
Poland:					
Blast furnace:					
Spiegeleisen	4	4	3	[r]3	4
Ferromanganese	93	99	88	94	94
Electric furnace:					
Ferromanganese[e 8]	53	53	54	54	54
Ferrosilicon[e]	57	56	57	56	55
Silicon metal[e]	11	11	12	12	11
Ferrochromium[e]	53	53	54	54	53
Other[e 11]	19	19	18	18	18
Total[7]	290	295	287	[r]291	289

See footnotes at end of table.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1] —Continued

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[e]
Portugal: Electric furnace:					
Ferromanganese[e, 17]	44	51	46	22	28
Silicomanganese[e, 17]	20	26	28	11	17
Ferrosilicon[e]	9	10	10	6	5
Silicon metal[e]	r11	12	13	6	6
Other[e]	(4)	(4)	(4)	(4)	(4)
Total[7]	85	99	96	46	55
Romania: Electric furnace[e]					
Ferromanganese	88	96	88	90	89
Silicomanganese	42	45	43	44	43
Ferrosilicon	53	57	55	56	55
Silicon metal	4	5	5	5	5
Ferrochromium	46	50	49	49	46
Total[7]	234	253	240	244	239
South Africa, Republic of: Furnace type unspecified[9]					
Ferromanganese	184	261	365	372	380
Silicomanganese	144	199	287	304	303
Ferrosilicon	55	99	83	92	94
Silicon metal	30	28	29	30	29
Ferrochromium	744	956	979	959	1,024
Ferrochromium-silicon	20	20	6	6	6
Other[18]	1	(4)	(4)	1	1
Total[e, 7]	r1,178	r1,563	r1,720	1,802	1,846
Spain: Electric furnace:					
Ferromanganese[e]	84	94	96	95	99
Silicomanganese[e]	77	77	77	77	77
Ferrosilicon[e]	68	66	67	67	66
Silicon metal[e]	76	66	68	68	77
Ferrochromium[e]	15	15	19	19	22
Other[e]	6	4	4	4	6
Total[e, 11]	279	321	331	r331	347
Sweden: Electric furnace:					
Ferrosilicon	21	26	31	r28	31
Silicon metal	22	23	r22	r22	22
Ferrochromium	132	148	149	r143	143
Ferrochromium-silicon	20	34	29	r28	28
Other	1	1	(4)	(4)	(4)
Total[11]	197	230	232	r221	226
Switzerland: Electric furnace[e]					
Ferrosilicon	2	3	3	3	3
Silicon metal	2	2	2	2	2
Total	4	5	5	5	5
Taiwan: Electric furnace:					
Ferromanganese	24	22	20	22	r19
Silicomanganese	20	25	25	23	r21
Ferrosilicon	20	26	19	15	r8
Total[7]	63	73	64	61	r47
Turkey: Electric furnace:					
Ferrosilicon[e]	5	r8	8	8	r1
Ferrochromium	33	53	r53	r55	r10
Total	38	61	r61	r63	r14
U.S.S.R.:					
Blast furnace:					
Spiegeleisen[e]	50	55	55	55	55
Ferromanganese[e]	606	606	606	606	606

See footnotes at end of table.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1] —Continued

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[e]
U.S.S.R.—Continued:					
Electric furnace:[13]					
Ferromanganese[e]	651	681	744	772	772
Silicomanganese[e]	187	198	209	220	220
Ferrosilicon[e]	791	827	875	892	903
Silicon metal[e]	70	70	66	72	73
Ferrochromium[e]	457	463	463	469	474
Ferrochromium-silicon[e]	13	13	13	14	13
Other[14]	250	250	274	265	265
Total[r]	2,994	3,144	3,237	3,354	3,415
United Kingdom:					
Blast furnace, ferromanganese	91	83	85	r82	89
Electric furnace, undistributed[e]	14	14	11	11	11
Total[r]	106	97	96	r94	99
United States: Electric furnace:[20]					
Ferromanganese	80	[21]171	[21]154	[21]117	e [21]119
Silicomanganese	W	[22]	[22]	[22]	[22]
Ferrosilicon	314	430	442	339	r356
Silicon metal	122	141	121	124	r147
Ferrochromium	98	[23]95	[23]110	[23]103	e [23]113
Ferrochromium-silicon[24]	16	[25]	[25]	[25]	[25]
Other[26]	138	130	151	130	150
Total[r]	757	1,088	977	810	884
Uruguay: Electric furnace, ferrosilicon	[4]	[4]	[4]	[4]	[4]
Venezuela: Electric furnace:					
Ferromanganese	2	2	r2		
Silicomanganese	16	16	24	23	24
Ferrosilicon	51	49	67	56	56
Total[r]	69	67	94	80	80
Yugoslavia: Electric furnace:					
Ferromanganese	44	49	r e42	r e44	44
Silicomanganese	29	41	r e74	r e72	72
Ferrosilicon	86	104	r e103	99	105
Silicon metal	28	31	r e31	r e24	29
Ferrochromium	70	69	r e52	r e56	59
Ferrochromium-silicon	9	12	r e10	r e11	11
Other	12	12	e12	17	17
Total[r]	r320	r318	325	331	356
Zimbabwe: Electric furnace:					
Ferromanganese	2	2	2	r2	2
Ferrosilicon	60	47	59	r53	55
Ferrochromium	174	196	172	r171	171
Total[r]	307	246	233	r228	228
Grand total[r]	r14,638	r16,477	16,432	16,221	16,264
Of which:					
Blast furnace:					
Spiegeleisen[27]	60	69	58	59	59
Ferromanganese[27]	1,236	1,418	1,325	1,291	1,288
Ferrosilicon	44	77	47	76	77
Total blast furnace	1,339	1,564	1,431	1,426	1,424
Electric furnace:[13]					
Ferromanganese[28]	r2,823	r3,154	3,128	3,058	2,992
Silicomanganese[28, 29]	r1,349	r1,642	1,650	1,643	1,620
Ferrosilicon	r3,278	r3,713	3,647	3,583	3,574
Silicon metal	r582	r688	689	706	762
Ferrochromium[30]	r2,626	r3,119	3,240	3,171	3,141
Ferrochromium-silicon[24, 30]	r68	101	82	80	82
Ferronickel	r495	r602	643	554	666
Other[31]	r440	r595	812	917	991
Undistributed	29	28	24	24	24
Total electric furnace	r12,195	r14,649	14,609	13,686	13,753

See footnotes at end of table.

Table 9.—Ferroalloys: World production, by country, furnace type, and alloy type[1] —Continued

(Thousand short tons)

Country, furnace type,[2] and alloy type[3]	1983	1984	1985	1986[p]	1987[e]
Furnace type unspecified:					
Ferromanganese[4]	r801	r878	982	1,109	1,177

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Table includes data available through July 15, 1988.

[2]To the extent possible, ferroalloy production of each country has been separated according to the furnace type from which production is obtained; production derived from metallothermic operations is included with electric furnace production.

[3]To the extent possible, ferroalloy production of each country has been separated so as to show individually the following major types of ferroalloys: spiegeleisen, ferromanganese, silicomanganese, ferrosilicon, silicon metal, ferrochromium, ferrochromium-silicon, and ferronickel. Ferroalloys other than those listed that have been identified specifically in sources, as well as those ferroalloys not identified specifically but which definitely exclude those listed previously in this footnote, have been reported as "Other." For countries for which one or more of the individual ferroalloys listed separately in this footnote have been inseparable from some other ferroalloys owing to the nation's reporting system, such deviations are indicated by individual footnotes. In instances where ferroalloy production has not been subdivided in sources, and where no basis is available for estimation of individual component ferroalloys, the entry has been reported as "Undistributed."

[4]Less than 1/2 unit.

[5]Data for year ending Nov. 30 of that stated.

[6]Reported figure.

[7]Data may not add to totals shown because of independent rounding.

[8]Includes silicomanganese.

[9]Although furnace type has not been specified for any ferroalloy production for China, North Korea, and the Republic of South Africa, all output of these countries has been included under "Electric furnace" (and metallothermic) output except for their production of ferromanganese, which is reported separately.

[10]Includes ferrochromium-silicon, if any was produced.

[11]Includes ferrochromium-silicon and ferronickel, if any was produced.

[12]Colombia is reported to produce ferromanganese alloy, but output is not reported quantitatively and no basis is available for estimation.

[13]Includes silicospiegeleisen.

[14]Includes ferronickel, if any was produced.

[15]Series excludes calcium silicide.

[16]Includes calcium-silicon, ferrotungsten, ferromolybdenum, ferrovanadium, ferrocolumbium, and other ferroalloys.

[17]Estimated figures based on reported exports and an allowance for domestic use.

[18]Ferrovanadium only; other minor ferroalloys may be produced, but no basis is available for estimation.

[19]Soviet production of electric furnace ferroalloys is not reported; estimates provided are based on crude source material production and availability for consumption (including estimates) and upon reported ferroalloy trade, including data from trading partner countries.

[20]U.S. production of ferronickel cannot be reported separately in order to conceal corporate proprietary information.

[21]U.S. output of ferromanganese for 1984-87 includes silicomanganese and manganese metal.

[22]U.S. output of silicomanganese for 1984-87 included with "Ferromanganese."

[23]U.S. output of ferrochromium for 1984-87 includes ferrochromium-silicon, chromium briquets, exothermic chromium additives, other miscellaneous chromium alloys, and chromium metal.

[24]U.S. output of ferrochromium-silicon includes chromium briquets, exothermic chromium additives, other miscellaneous chromium alloys, and chromium metal.

[25]U.S. output of ferrochromium-silicon for 1984-87 included with "Ferrochromium."

[26]Includes ferronickel.

[27]Spiegeleisen for the Federal Republic of Germany is included with "Blast furnace ferromanganese."

[28]"Ferromanganese" includes silicomanganese (if any was produced) for countries carrying footnote 8 on "Ferromanganese" data line.

[29]Includes silicospiegeleisen for France.

[30]"Ferrochromium" includes ferrochromium-silicon (if any was produced) for countries carrying footnote 10 on "Ferrochromium" data line.

[31]Other includes ferronickel production for France, Norway, the U.S.S.R., and the United States.

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